

# California & the Great Basin: Coping with Drought to El Niño

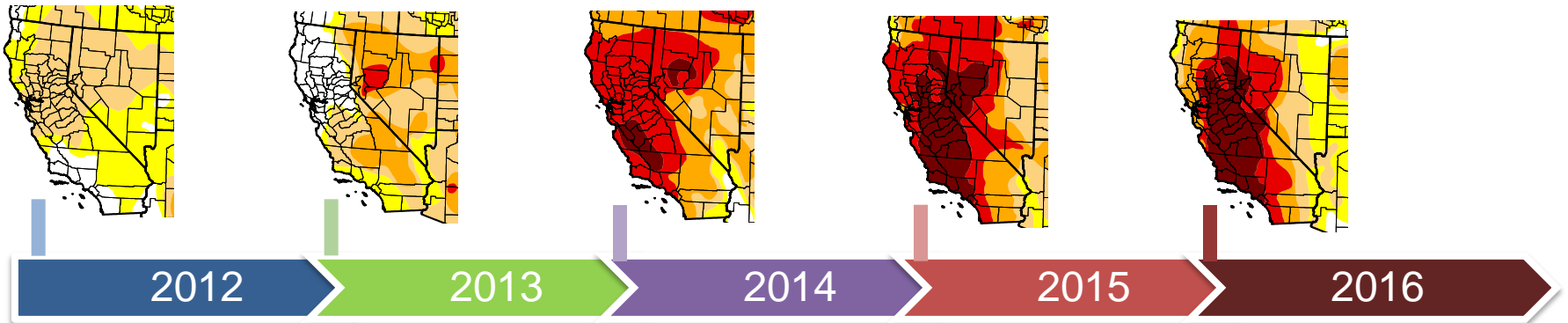
A contribution to RISA session:  
*Fast and Slow, Big and Small: Extreme Events  
and Agencies Needs*

Julie Kalansky, Amanda Sheffiedl, Dan Cayan

*Insert some  
kind of  
background  
image to the  
slide?*



NIDIS

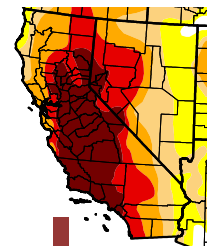
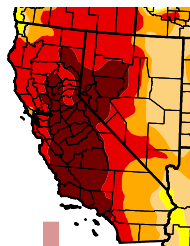
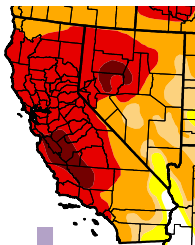
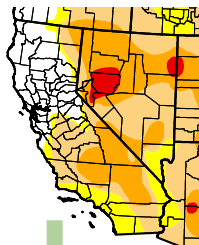
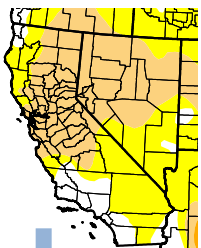


## Development of the 2012-2015+ drought in California and Nevada

NIDIS

Amanda Sheffield

**CNAP**  
California-Nevada Climate Applications Program  
A NOAA RISA team



2012

2013

2014

2015

2016

San Joaquin irrigation deliveries begin months early

Yosemite Falls stops flowing for 5 months

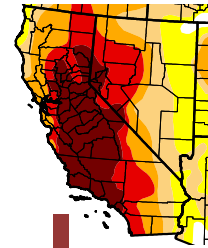
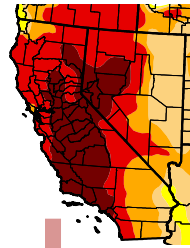
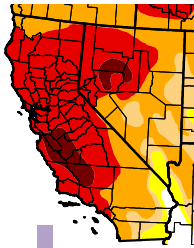
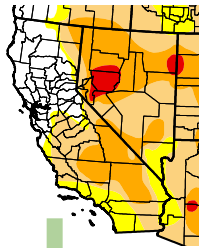
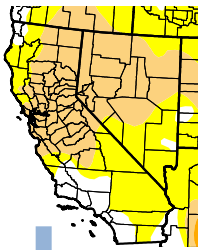
BLM in NV first of many roundups of wild horses and burros

Several CA counties declare drought emergency in prep for state/federal

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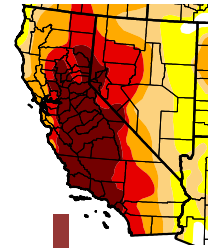
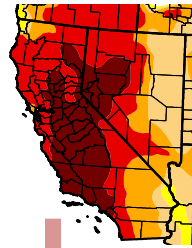
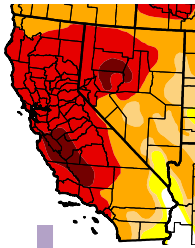
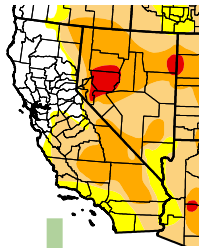
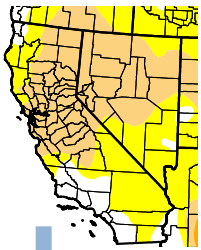
CA DWR increases Small Water Systems focus

North/Central CA Event where particulate levels above Federal public health standards

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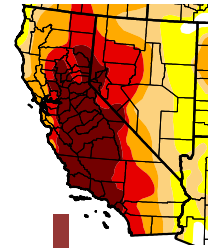
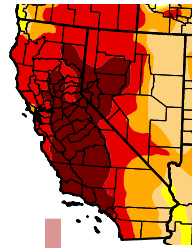
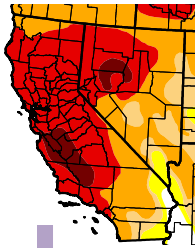
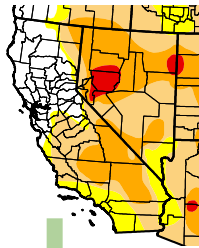
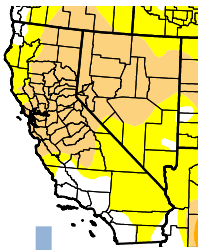
3 Truckee River hydropower plants temporarily close

AZ/NV/CA Native American tribes receive \$43 million from EPA

CA enacts SGMA

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Sierra Snowpack at 5% of April 1 average

CalFire ups staff in prep for season (2 months earlier than usual)

NV Drought Forum begins

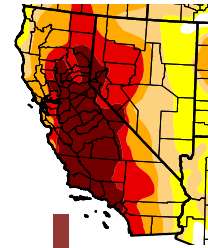
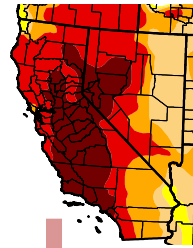
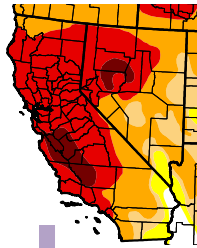
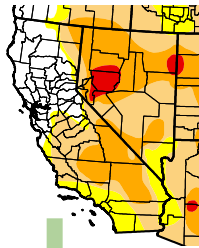
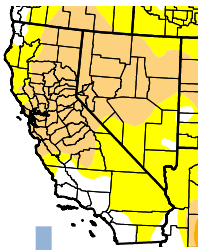
Extensive Salmon death in Sacramento River

Gov. Sandoval hosts Drought Summit

29 million (and counting) dead trees in CA

Valley Fire (76,000 acres, 4 dead, 1958 structures)

Amanda Sheffield



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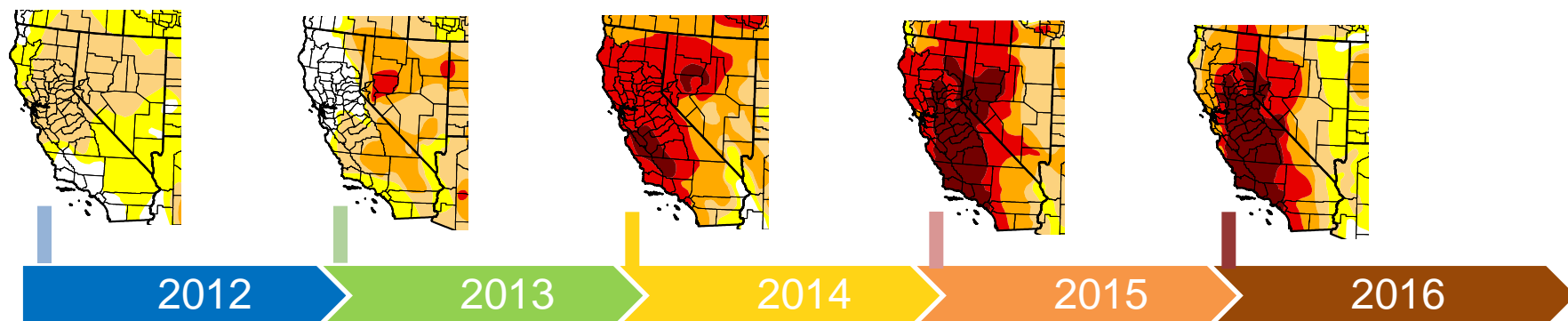
CA DWR identifies 21 ground water basins critically over drafted

Folsom Lake nears legal capacity

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# Drought: Federal, State and Local Issues



**What is causing the drought?**

**Is this climate change?**

**How much water do we have left?**

**How does drought affect wildland fires?**

**When will the drought end? What will it take?**

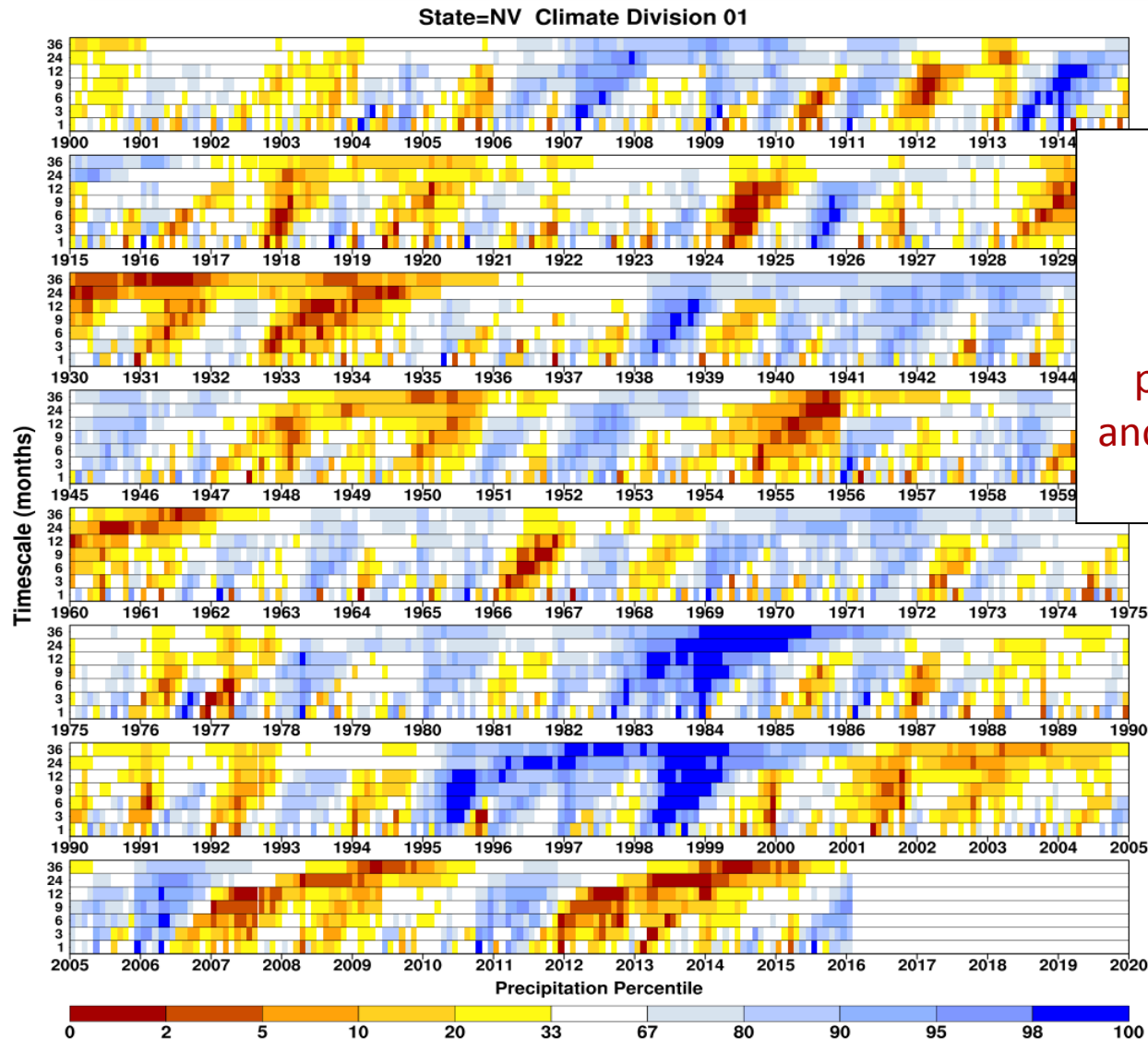
Amanda Sheffield

**NIDIS**



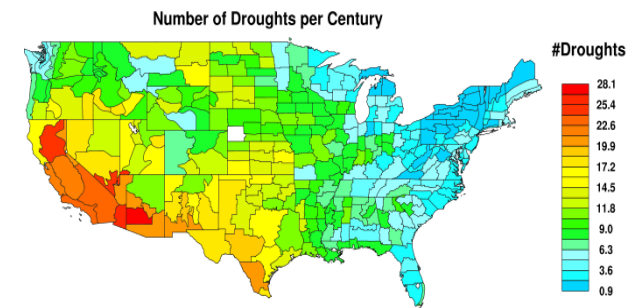
# Drought Percentile Indices 1-24 month time scales

does 2012-15 CA/NV drought fit the historical pattern? climate change?




Nevada  
Climate Division 1

Precipitation is only  
part of the drought story  
anomalous temperature also  
plays an important role



Sam Iacobellis with  
Steinemann et al. , 2014  
Shukla et al 2016

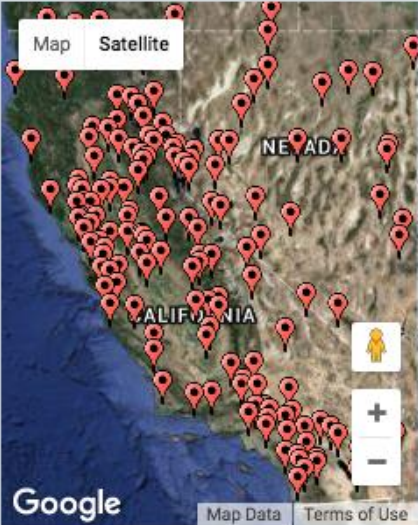
# When will the drought end & what will it take?



CLIMATE OUTCOME LIKELIHOOD  
*Supporting California's climate-related decisions*


[Home](#) [About This Tool](#) [Data and Resources](#)

Map Satellite



Google Map Data Terms of Use

Stations shown on map are in the GHCN and have records beginning 1920 or earlier to present. Read more in [documentation](#).



### Options Selection

**What can this tool do?** Determine the likelihood of recovering a precipitation deficit or reaching a precipitation threshold during some future period based on historic station data. [Read more](#)

**Station (choose on map) ?**  
GHCN station selected:  
Sacramento 5 ESE, 23271  
\*8 and 5 station indices coming soon!

**Date Range Selection: ?**  
Calculate observed precipitation  
From: 2015-08-18  
To: 2016-02-18  
and likelihood of precipitation outcomes during recovery period  
ending: 2016-08-18

**Data Options: ?**

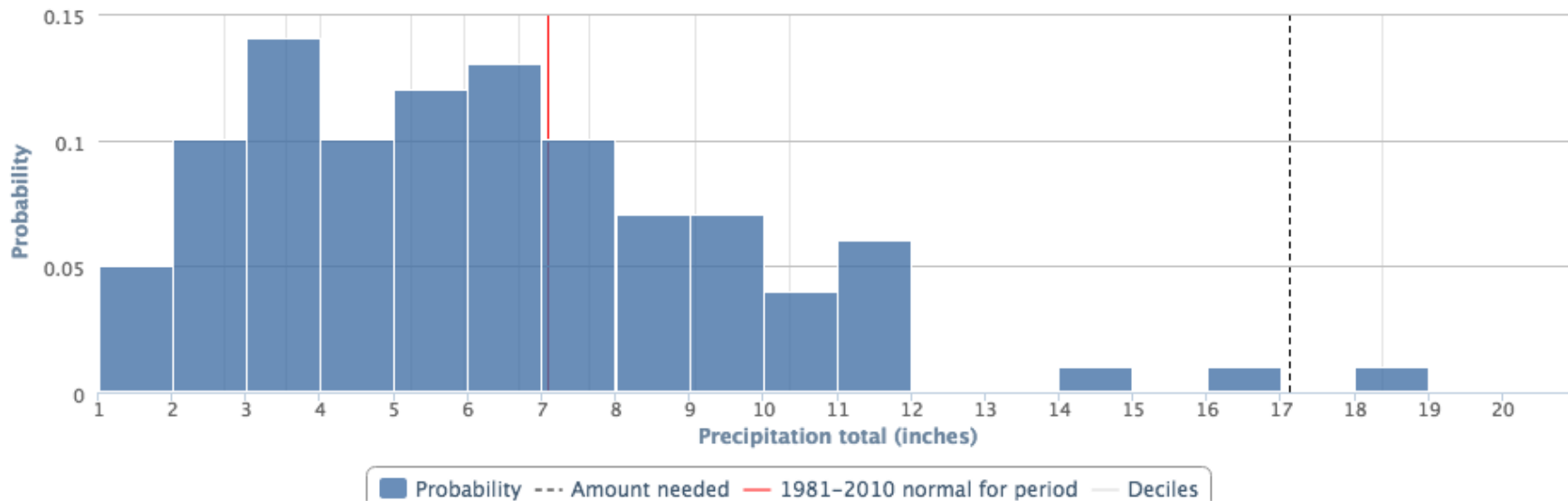
- ☒ Analyze observed data in station record
- ☐ Analyze random daily samples from station record
- ☐ Analyze analog periods in station record

**Graphics Options: ?**

- ☒ Show probability density function graph
- ☐ Show cumulative distribution function graph
- ☐ Show both

Nina Oakley, DRI

Probability Density Function for 02-18 through 09-30 for precipitation at SACRAMENTO 5 ESE, CA  
based on observed data in station record



There is a 0.74% chance of reaching/exceeding normal by end of recovery period based on 135 periods in station record.

Powered by ACIS

Western Regional Climate Center

**Analysis for: SACRAMENTO 5 ESE, CA** ? **How to interpret graph**

Precipitation accumulated from 2014-08-18 to 2016-02-17:  
23.79 in. (2 missing days)

There is a deficit of 10.02 in. for this period. Normal for this period is 33.81 in.

Amount needed to reach/exceed normal by 2016-09-30:  
17.12 in.

Likelihood of recovery between 2016-02-18 and 2016-09-30:  
**0.74%**

135 of 139 records used based on station record 1877-07-11 to 2016-02-15

<http://wrcc.dri.edu/col/>

Nina Oakley, DRI

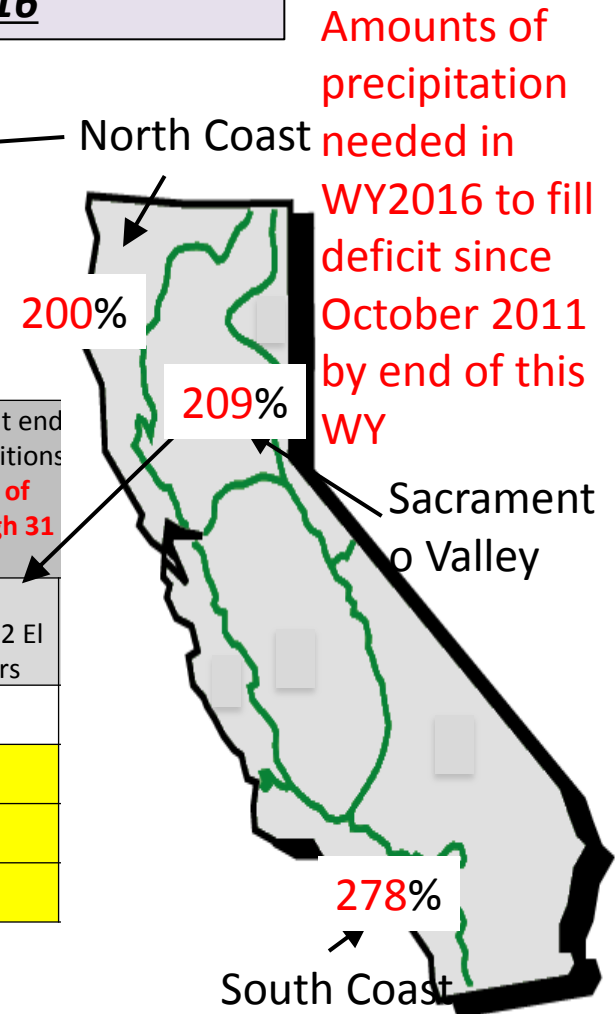
**Odds of reaching 100%, 125% or 150% of normal precipitation for the entire Water Year 2016 (1 Oct 2015 – 30 Sept 2016) based on observed precipitation *through January 2016***

North Coast Division	Odds of reaching WY target at end of water year, based on conditions on 1/31/2016 being <b>118% of normal precipitation through 31 Jan</b>	
Total at end of WY	Based on All years	Based on 22 El Nino years
75%	91%	95%
100%	55%	68%
125%	23%	45%
150%	8%	22%

Sacramento Valley Division	Odds of reaching WY target at end of water year, based on conditions on 1/31/2016 being <b>109% of normal precipitation through 31 Jan</b>	
Total at end of WY	Based on All years	Based on 22 El Nino years
75%	99%	100%
100%	56%	52%
125%	12%	21%
150%	1%	5%

South Coast Division	Odds of reaching WY target at end of water year, based on conditions on 1/31/2016 being <b>75% of normal precipitation through 31 Jan</b>	
Total at end of WY	Based on All years	Based on 22 El Nino years
75%	76%	68%
100%	14%	27%
125%	2%	5%
150%	0%	0%

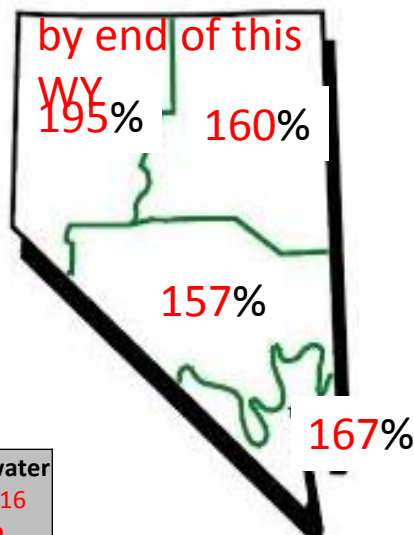
*As of 01 Feb 2016*



Contacts: M. Dettinger

Northwest Division	Odds of reaching WY target at end of water year, based on conditions on 1/31/2016 being 155% of normal precipitation through 31 Jan	
Total at end of WY	Based on All years	Based on 22 El Nino years
75%	100%	100%
100%	88%	96%
125%	31%	35%
150%	6%	10%

Amounts of precipitation needed in WY2016 to fill deficit since October 2011 by end of this WY



*As of 01 Feb 2016*

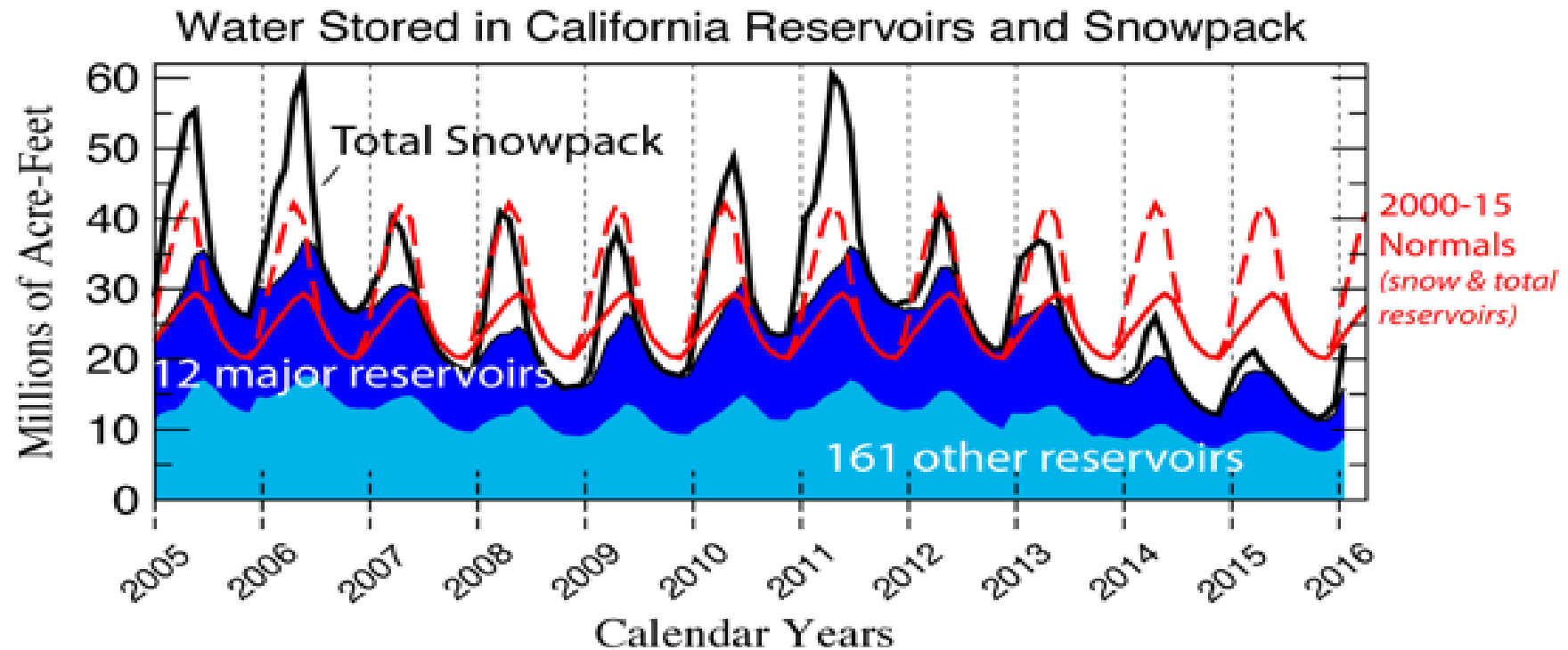
Extreme Southern Division	Odds of reaching WY target at end of water year, based on conditions on 1/31/2016 being 140% of normal precipitation through 31 Jan	
Total at end of WY	Based on All years	Based on 22 El Nino years
75%	95%	99%
100%	69%	83%
125%	33%	48%
150%	8%	18%

Northeast Division	Odds of reaching WY target at end of water year, based on conditions on 1/31/2016 being 164% of normal precipitation through 31 Jan	
Total at end of WY	Based on All years	Based on 22 El Nino years
75%	100%	100%
100%	92%	91%
125%	40%	33%
150%	5%	14%

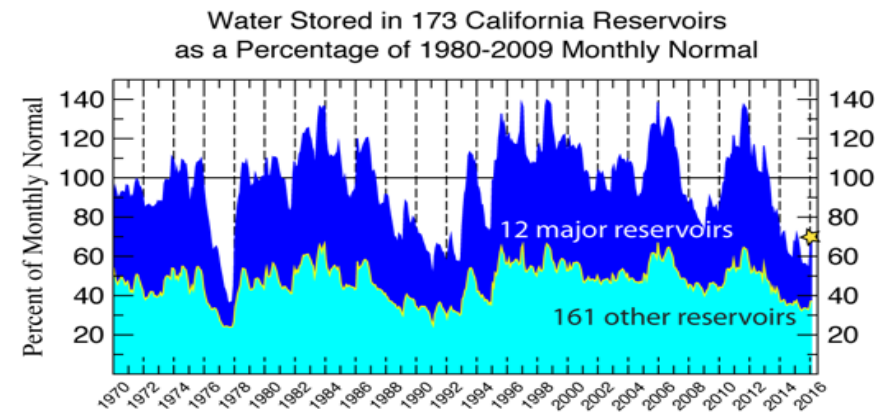
South Central Division	Odds of reaching WY target at end of water year, based on conditions on 1/31/2016 being 175% of normal precipitation through 31 Jan	
Total at end of WY	Based on All years	Based on 22 El Nino years
75%	100%	100%
100%	85%	95%
125%	40%	59%
150%	8%	18%

Source: Mike Dettinger,  
mddettin@usgs.gov

# How much water do we have?

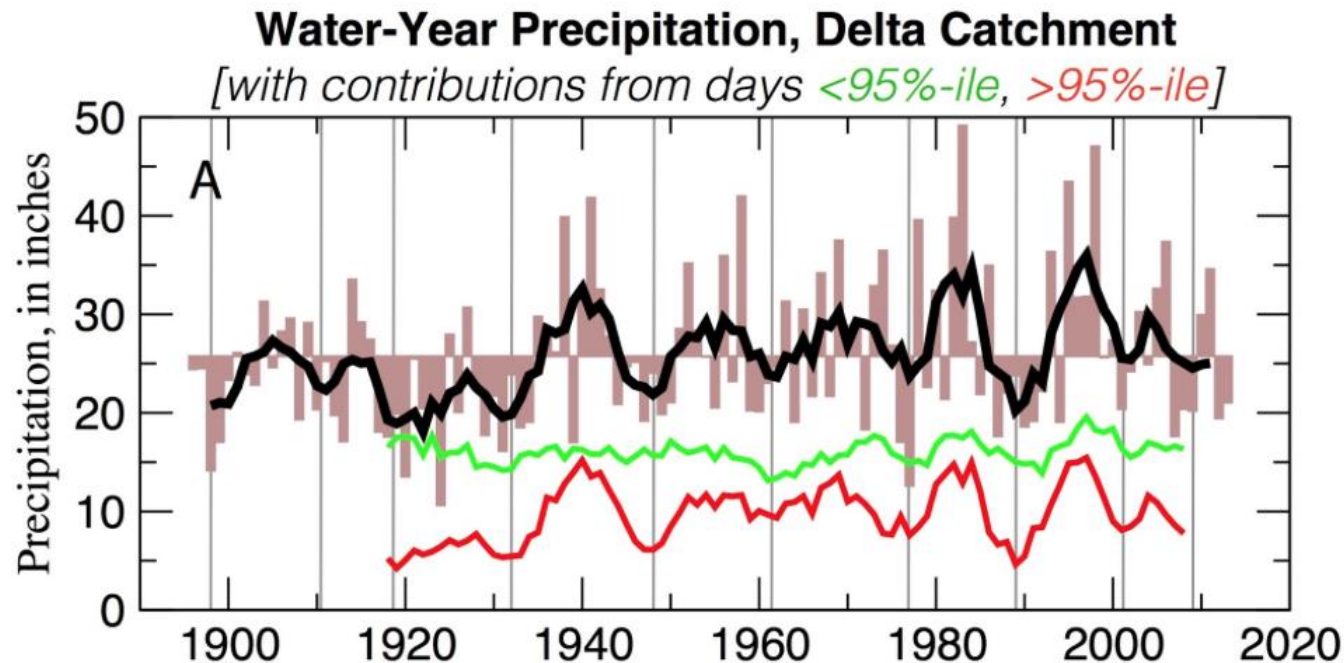


Dettinger and Anderson 2015





# What is causing the Drought?



## 95-th %-ile contributions

$R^{*2} = 92\%$  (5-yr mavg)  
= 85% (unfiltered)

**Avg Contrib: 38%**

**StdDev: 70%**

## Other wet days

$R^{*2} = 24\%$  (5-yr mavg)  
= 45% (unfiltered)

**Avg Contrib: 62%**

**StdDev: 38%**

# El Niño Effects?



# Local: Will El Niño cause flooding?

## Do California's largest floods occur during El Niño?

With a strong El Niño expected this winter, many communities worry about an increased risk of flooding. The highest peak flows of California's coastal rivers (Russian River for example, Figure 3 top) have been observed in El Niño, neutral, and La Niña years. In contrast, Sierra Nevada rivers (Merced River for example, Figure 3 bottom) generally observe their highest peak flows in neutral or La Niña years. Flooding in CA and NV is often associated with atmospheric rivers, narrow plumes of high water vapor transport. Preliminary research suggests the development of atmospheric rivers over the Pacific is slightly less favorable during El Niño conditions. However, flooding can occur during any season and any year in both CA and NV. Residents and decision-makers should remain vigilant and take necessary

From CNAP El Niño two pager produced by CNAP and also appeared in the *Floodplain Management Association* Newsletter

Forecasts show the chance of temperature/precipitation being among the top, middle, or bottom 1/3 (tercile) of all observed values at a location. Nearly all of California and Nevada are favored to be in the upper tercile (>66th percentile) for temperature and precipitation for Jan-Mar.

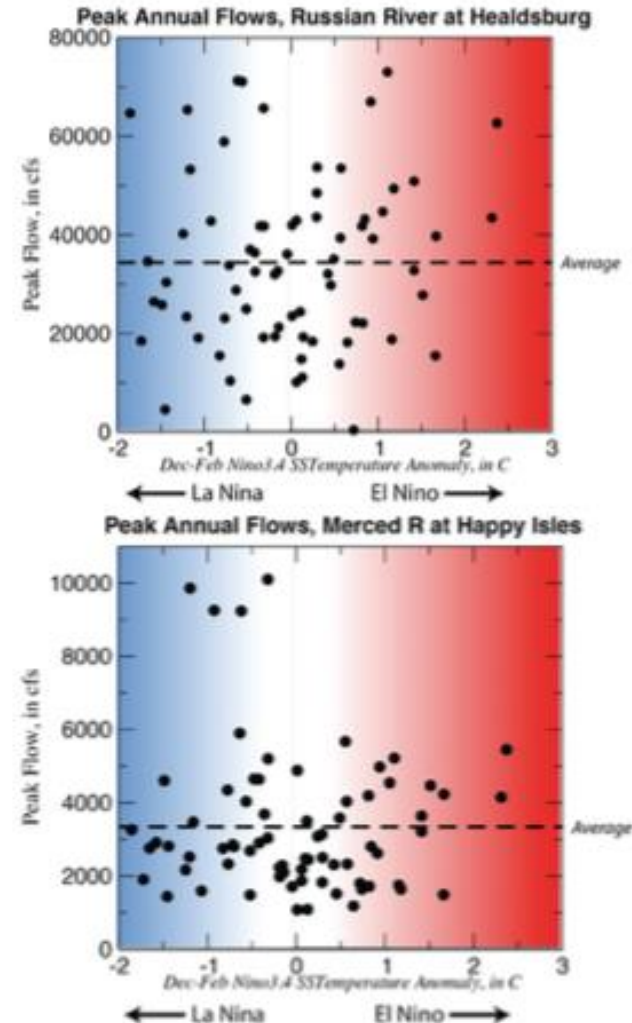
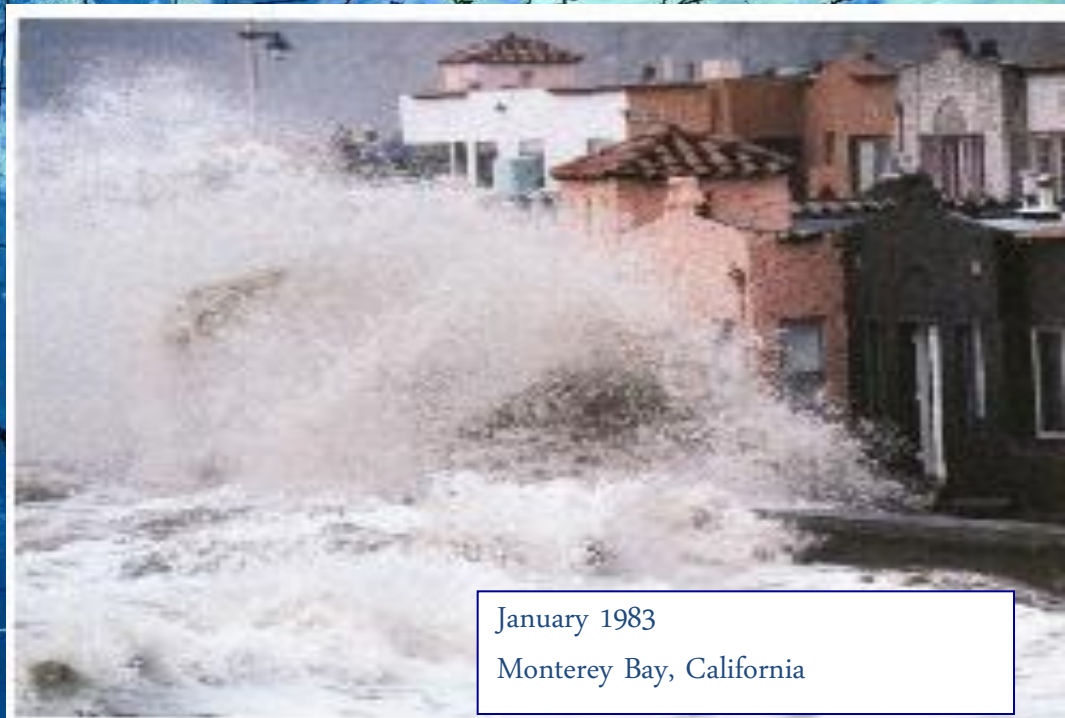
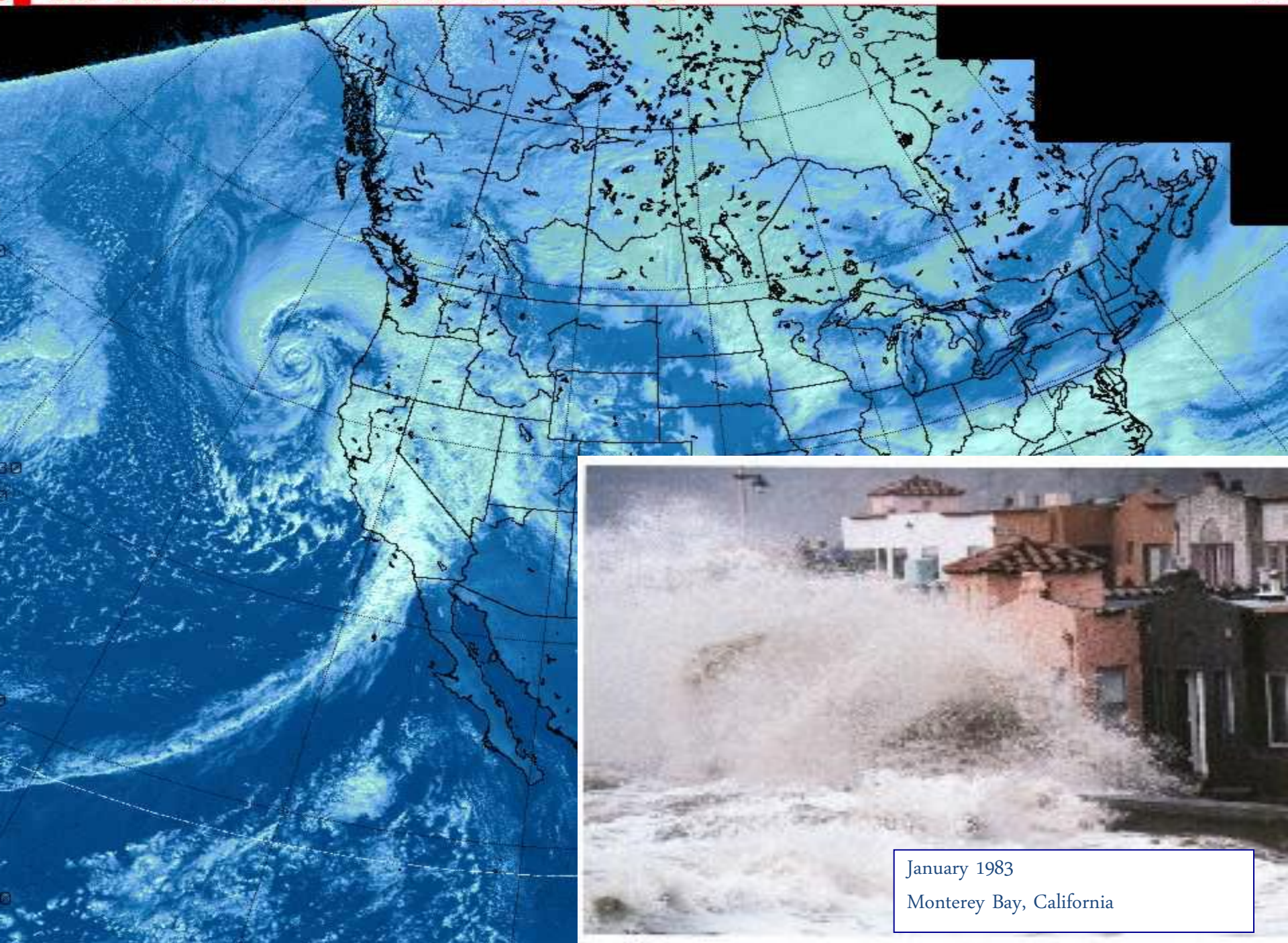


Figure 3. Peak flows of the Russian River in coastal northern CA (top) and the Merced River in central interior CA (bottom) for each year from 1940 to 2014. Data source: USGS

Mike Dettinger





January 1983  
Monterey Bay, California

# Local: Will El Niño cause flooding?

[cnap.ucsd.edu/sealevel](http://cnap.ucsd.edu/sealevel)

## Daily Sea Level Anomalies

The figure below shows the predicted and observed sea level heights for the period October 2015 to April 2016. The blue line represents the predicted water level (astronomical tide) with the black dots denoting the daily maximum predicted water level. The red dots show the observed daily maximum water level. The middle panel shows the difference between the observed and predicted daily maximum water level. The bottom panel presents a long-term view of the observed daily maximum water level going back to 1950 (when data available).

Data is currently available at the locations shown in the adjacent map. By default, this page will load the figure for San Francisco. Click on the location names below to view figures for the other sites.

Crescent City  
San Francisco  
Santa Barbara

Eureka  
Monterey  
Los Angeles

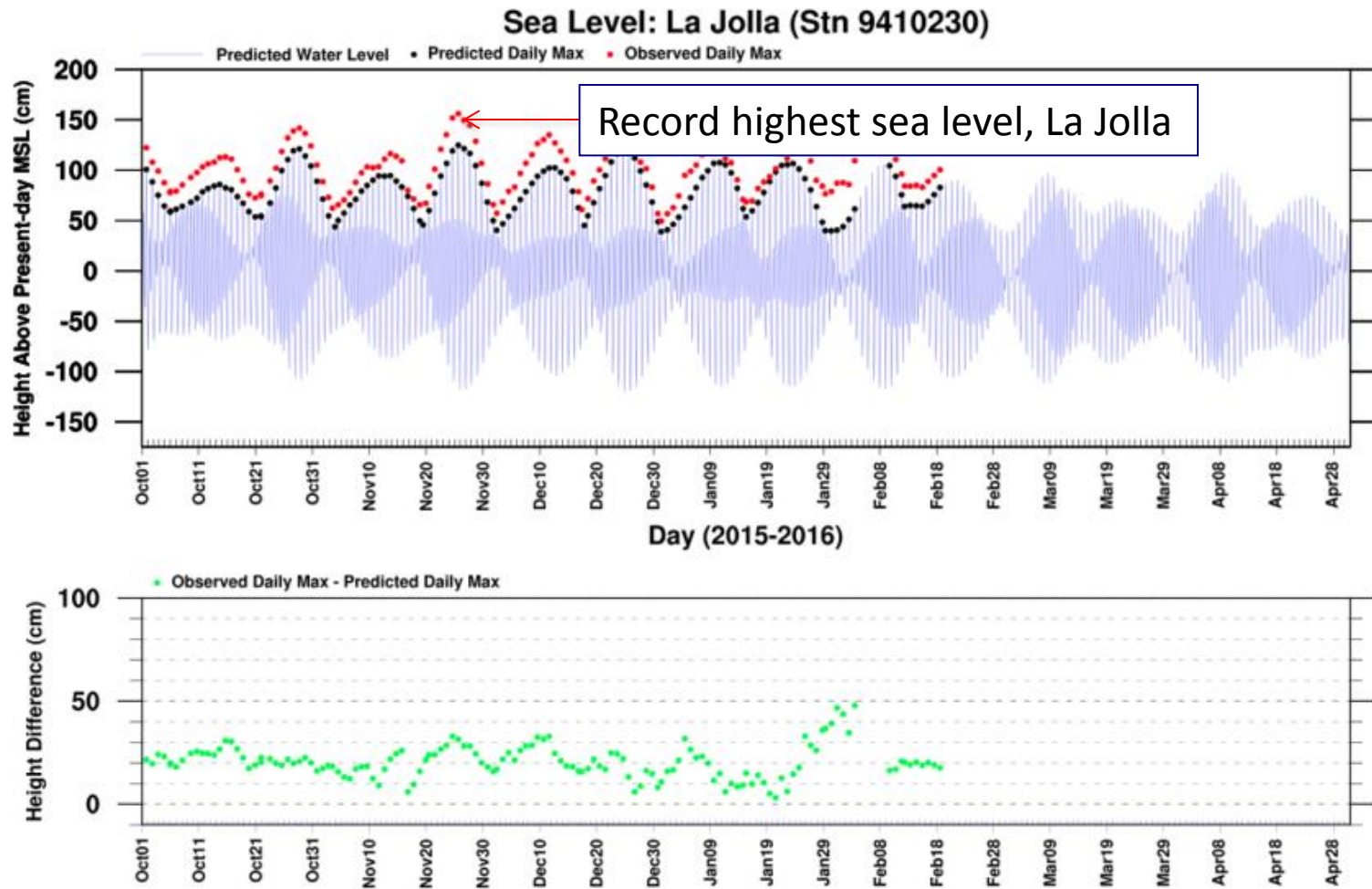
Point Arena  
Port San Luis  
La Jolla





# Local: Will El Niño cause flooding?

[cnap.ucsd.edu/sealevel](http://cnap.ucsd.edu/sealevel)



# PILOTING NON-STATIONARY APPROACHES TO FLOODPLAIN MANAGEMENT: SUPPORTING LOCAL COMMUNITIES AND INFORMING NATIONAL POLICY

A MULTI-INSTITUTIONAL SUBMISSION TO:  
NOAA CLIMATE PROGRAM OFFICE  
COASTAL AND OCEAN CLIMATE APPLICATIONS  
FY 2013: NOAA-OAR-CPO-2013-2003445

Aaron McGregor, Ryan Meyer, California Ocean Science Trust  
Peter Bromirski, Dan Cayan Scripps Institution of Oceanography  
Jeanine Jones, California Department of Water Resources

A recent survey shows that:  
*coastal managers in California lack training, resources, and Information relevant and usable within their decision making context.*

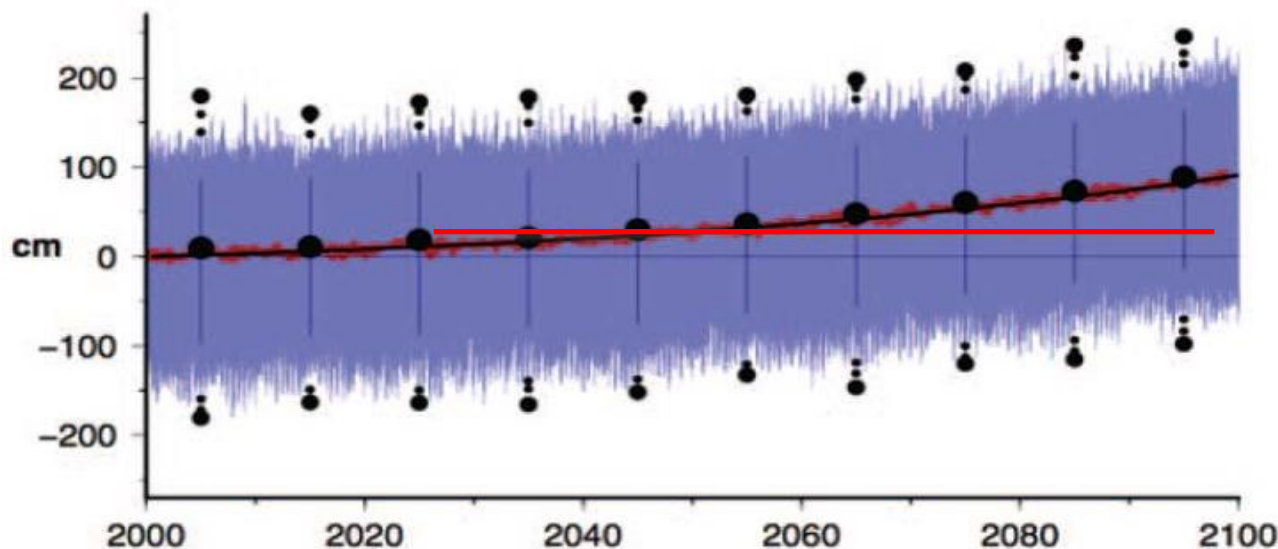
This project takes newly available information about sea-level rise, and translates it into products relevant to coastal planners, and which can be “mainstreamed” into existing programs.

As presently constituted, FEMA does not address climate change impacts in the NFIP, although there is a general provision allowing program applicants to consider “expected future conditions” in the context of program compliance. Consequently, this study was designed to provide a background to support local planners in taking sea-level rise and additional coastal processes such as waves and tides into account as part of assessing risk of coastal flooding.

## RELATING FUTURE COASTAL CONDITIONS TO EXISTING FEMA FLOOD HAZARD MAPS

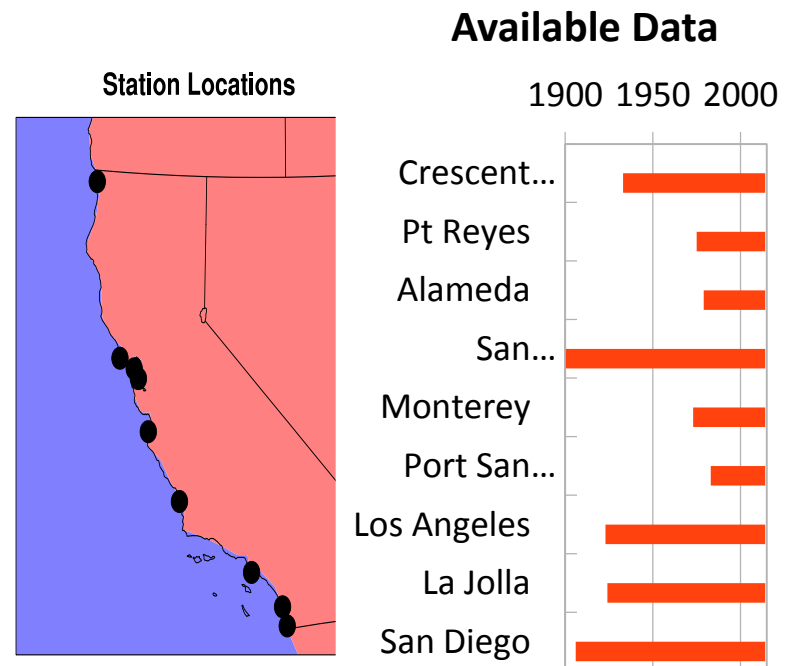
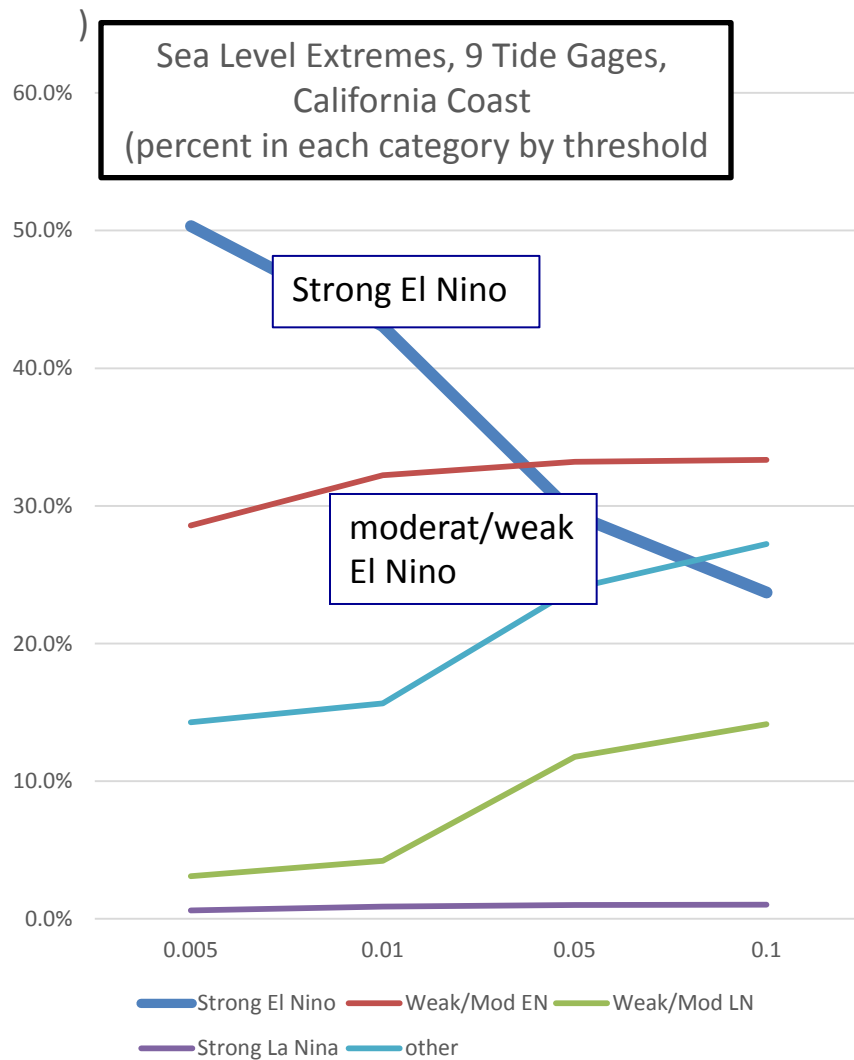
### Technical Methods Manual

Prepared for Department of Water Resources and California Ocean Trust, December 2015



water levels from 2000 to 2100 using the NRC mid-level sea level rise curve for San Francisco. \thick red lines are annual averages of the four SRES CMIP3 projections; blue lines (background cloud) are the maximum and minimum levels for each month; black circles show decadal (centered) values computed as the median, highest/lowest, 10th highest/lowest and 100th highest/lowest).

High Sea Levels  
occur most often  
during strong El Niños



# **Slow Onset Climate Extremes**

## **Lessons learned**

- federal, state and local climate requests have had much in common
- “Slow” climate episodes strongly affected by extreme events (or lack of).
- Use historical examples, explain uncertainty
- Information needs have changed due to:
  - the event evolving
  - stakeholders increasing their climate awareness





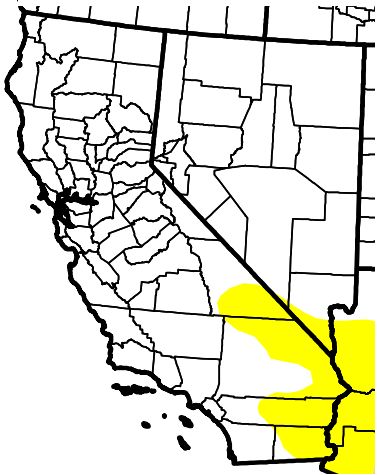
# State and Local



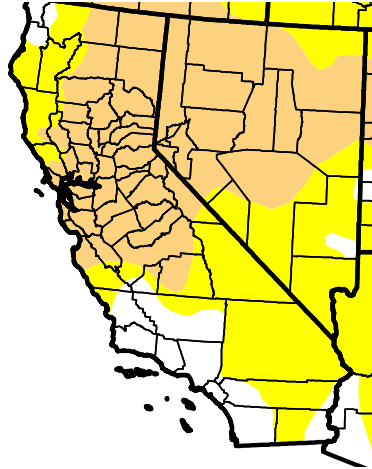
Governor Brown Declared a state of emergency because of CA drought Jan 2014 mandating water reductions of 25% across CA

# 2012-15 Drought Long duration and slow onset

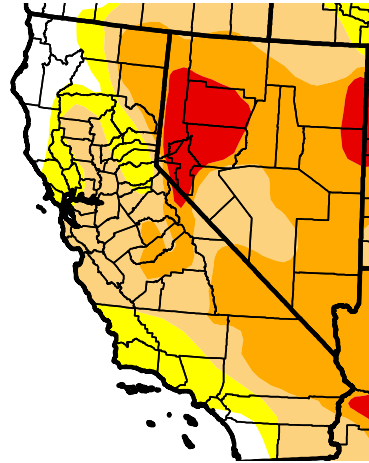
July 2011



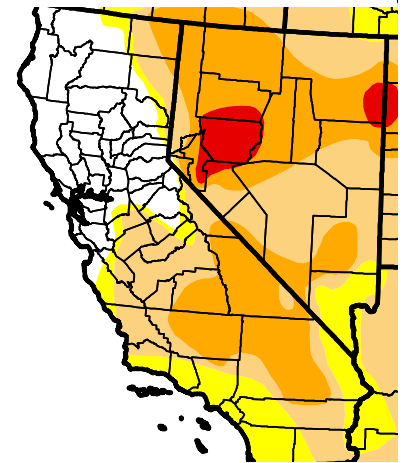
Jan 2012



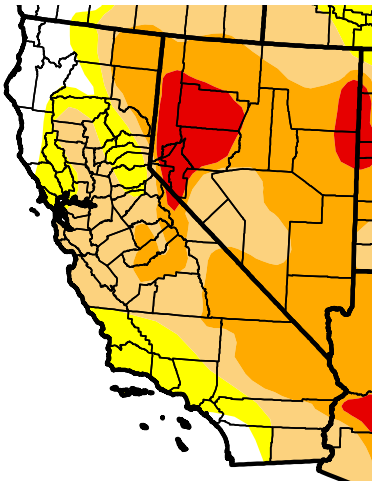
July 2012



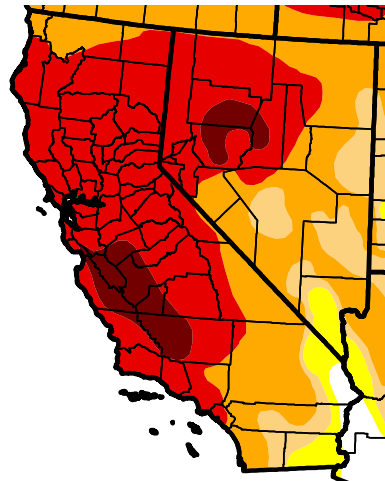
Jan 2013



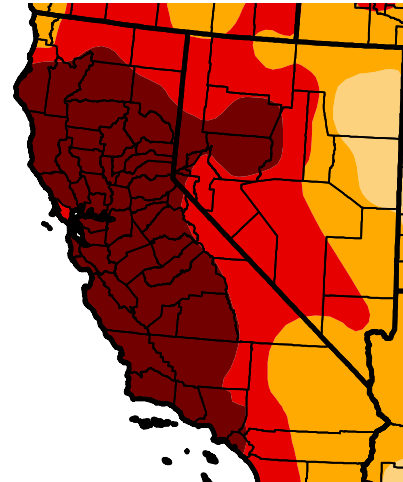
July 2013



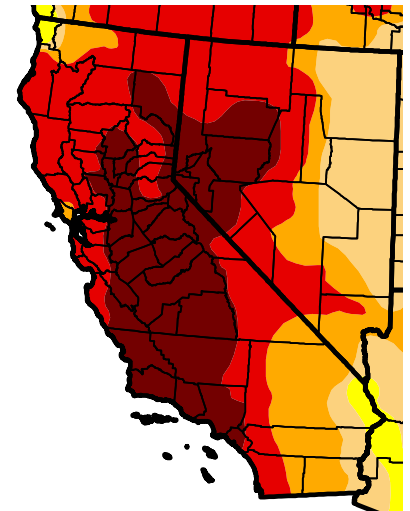
Jan 2014



July 2014



Jan 2015



# State and Local



## **San Diego County Water Authority**

4677 Overland Avenue • San Diego, California 92123-1233  
(858) 522-6600 FAX (858) 522-6568 [www.sdcwa.org](http://www.sdcwa.org)

January 6, 2016

To: [Kathy.Frevert@waterboards.ca.gov](mailto:Kathy.Frevert@waterboards.ca.gov)

**Subject: “Comments on Proposed Regulatory Framework”**

### MEMBER AGENCIES

Carlsbad  
Municipal Water District

City of Del Mar

City of Escondido

City of National City

City of Oceanside

City of Poway

City of San Diego

Fallbrook  
Public Utility District

Helix Water District

Olivenhain  
Municipal Water District

Oray Water District

Padre Dam  
Municipal Water District

Camp Pendleton  
Marine Corps Base

Rainbow  
Municipal Water District

Thomas Howard, Executive Director  
State Water Resources Control Board  
1001 I Street, 24th Floor  
Sacramento, CA 95814

Dear Mr. Howard:

The San Diego County Water Authority appreciates efforts by the State Water Resources Control Board staff to propose revisions to the Emergency Regulation. The Proposed Framework begins to address the inequities of the current one-size-fits-all regulatory policy, but it does not go far enough to reflect significant regional supply reliability differences throughout the state. For a state as diverse and complex as California, it is a disservice to the residents and businesses of the state to not fully account for the supply conditions and water management efforts of local communities.

Based on this principle, our comments focus on three main areas of the proposed

# El Niño: Slow "ish" Onset

- Describe the El Nino this year, also slow versus fast onset characteristics
- El Nino: graph of the SIOs value since winter of 2015
- [http://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/ensostuff/ensoyears.shtml](http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml)
- Include here headlines about El Nino and drought

# Wildfire and Drought?

Hosted first ever NIDIS workshop on drought and wildfire

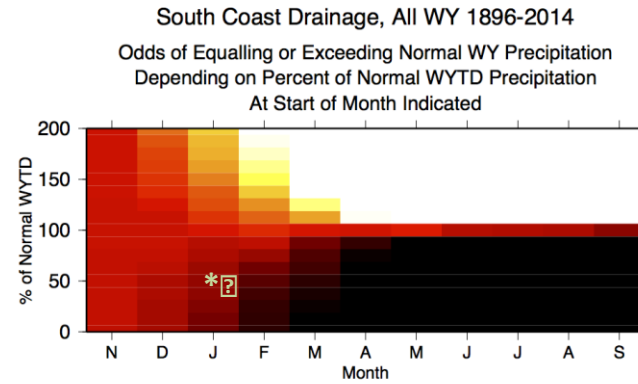
Asked Tim for some key points from the meeting



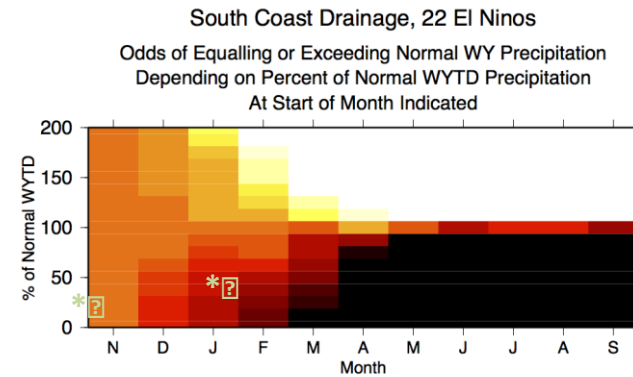
Wildfires in 2015  
in CA and NV  
[ww2.kqed.org](http://ww2.kqed.org)

Normal?  
Precip??

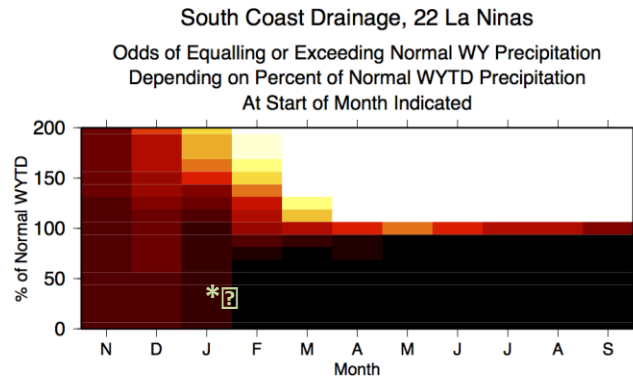
South C  
Californi



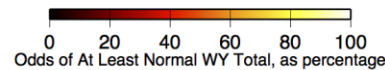
All Yrs?



El Ninos?



La Ninas?



# State: Will El Niño end the drought?

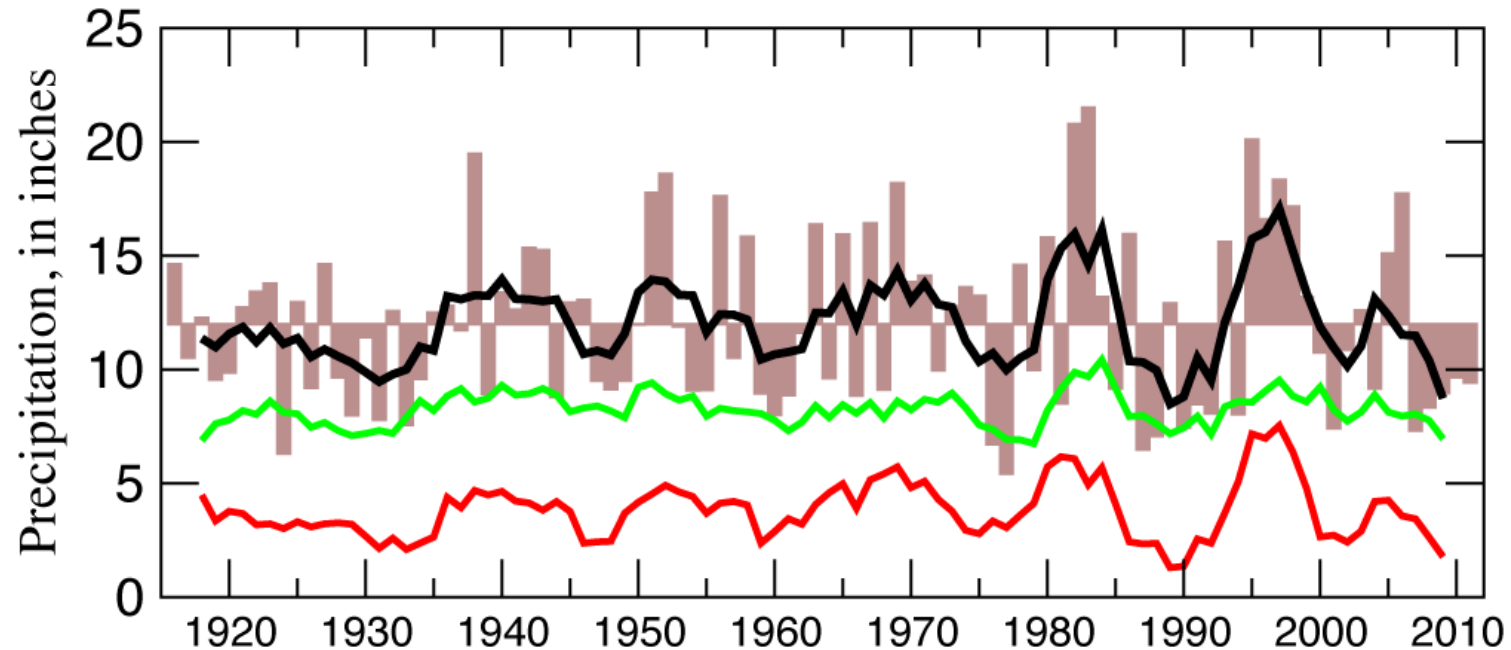
- Dave's online work



# What is causing the Drought?

## Water Year Precipitation, Tahoe-Reno-Carson

[with contributions from days <95%-ile and >95%-ile]



### 95-th %-ile contributions

**$R^{**2} = 89\%$  (5-yr mavg)**  
 **$= 75\%$  (unfiltered)**

**Average contribution: 32%**  
**Standard deviation: 70%**

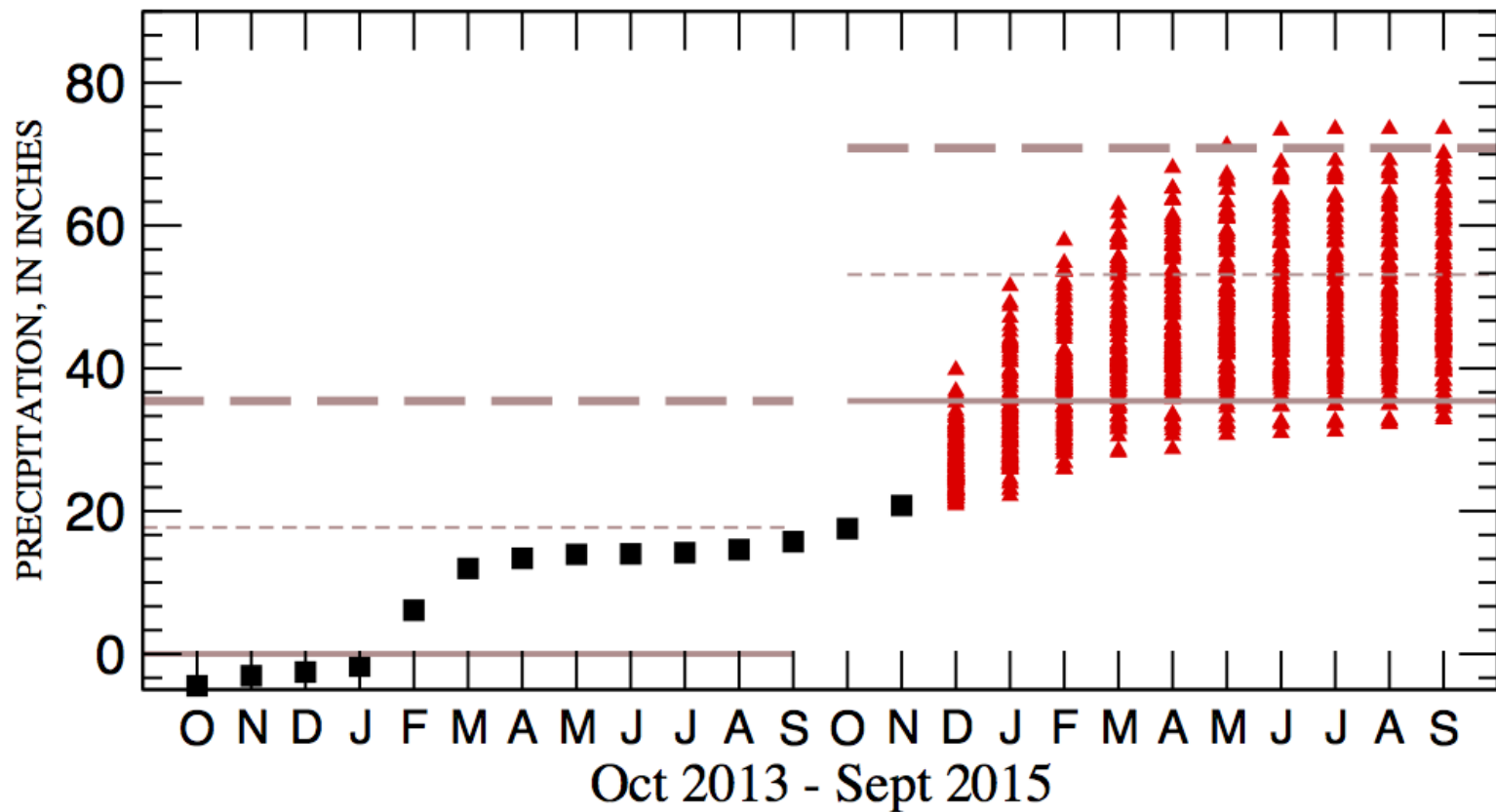
### Other wet days

**$R^{**2} = 68\%$  (5-yr mavg)**  
 **$= 55\%$  (unfiltered)**

**Average contribution: 68%**  
**Standard deviation: 41%**

# What will it take to end the drought?

California Sacramento Drainage



during high sea levels, the sea is often *not* quiescent



January 1983 Monterey Bay, California